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The Impact of Standardization Intensity on Sales Performance: Evidence from Korean SMEs†

중소기업의 표준화 집중도가 기업의 매출성과에 미치는 영향

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목 차

국 문 요 약

표준화에 대한 투자와 연구개발에 대한 투자는 중소기업의 기업운영 방향성을 결정짓는 두 가지 주요한 전략이다. 동 연구는 중소기업의 표준화에 대한 투자가 기업의 매출 성과에 미치는 영향을 알아보고자 한다. 특히, 단순히 표준화 집중도를 살펴보는 것이 아니라 표준화에 대한 집중도와 연구개발에 대한 집중도를 함께 고려한 기업의 매출 성과에 미치는 영향을 분석하고자 한다. 2013년 한국표준협회에서 수행한 한국표준조사를 바탕으로 정보통신산업과 전기전자산업에 속하는 821개 기업을 대상으로 회귀분석을 수행하였다. 그 결과 중소기업의 연구개발 집중도 대비 표준화에 대한 투자는 그 기업의 매출 성과에 비선형관계(U자형)가 있음을 알 수 있었다. 본 연구결과는 중소기업의 경우 표준화에 대한 집중도 혹은 연구개발에 대한 집중도가 균형을 갖춘 접근보다는 하나에 집중하는 것이 매출성과에 도움 된다는 것을 시사한다.

핵심어 : 표준화 집중도, 기업의 매출성과, 중소기업, 정보통신산업, 전기전자산업

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ABSTRACT

The choice of SMEs between standardization and R&D is one of the strategies of building capabilities for achieving competitive advantages under the liabilities of newness and smallness. This paper provides empirical evidence of Korean SMEs choice between standardization and R&D. We hypothesize two possible impacts of standardization intensity on sales performance; a positive linear and a U-shaped relationship. The analysis of data on 821 Korean SMEs from information and technology, and electricity and electronics industries in 2013 shows an U-shaped relationship between relative standardization intensity over R&D and sales performance.

Key Words : Standardization intensity, Sales performance, Small and Medium sized Enterprise, Information and Communication Industries, Electricity and Electronics Industries

I. Introduction

Today, standards are considered an important capability of many industries and the outcome of standard-based competition significantly influences the fate of firms. The fast pace of technological change and the increasing level of technology complexity highlight the strong link between technological standards and market performance (Stango, 2004). Standards can be designed by Standards Development Organizations (SDO) or can become established within a market *de facto*, i.e., as a consequence of the market power of a single or dominant supplier (Utterback, 1996). They provide for compatibilities between products or systems, enhance quality, efficiently reduce variety, and promote the spread of new technology (Temple et al., 2005).

Investment on standardization implies two strategies depending on the given circumstances. Standardization investment when there is *de facto* standards in the market means that firms follow de facto standards to enter or to win the race in the industry characterizing less product and market uncertainties. Whereas investment on standardization when there is no de facto standards in the market implies that firms target to generate the de facto standards in the market to capture almost all market share. As these two strategic meanings imply, standardization is critical to determine a firm's performance. However it is surprising that there have been relatively less evidence of how a firm's standardization strategy impacts its performance unlike R&D investment.

To date, much research has studied the influences of firm's R&D capability, but those of firm's standardization capability remain largely unexplored. Although research papers on standardization has continuously grown (Choi, Lee, & Sung, 2011), most of existing standardization literature has focused on specific case studies (Allen & Sriram, 2000; Gallagher, 2012; Ohashi, 2003; Reddy, 1990; Yoo, Lyytinen, & Yang, 2005), economic outcomes of standardization in terms of macro aspect (Blind & Jungmittag, 2005; Jungmittag & Welfens, 2002; Temple et al., 2005), or the relationship between standardization and innovation (Allen & Sriram, 2000; Choi et al., 2011; Kano, 2000). Previous studies have seen standardization as a part of innovation process (Miller & Morris, 1999) or either an inhibitor or a catalyst of innovation (Blind, 2009). However,

standardization as a firm's strategic choice and its performance implications have received less emphasis and little empirical research has examined the relationships between standardization and performance at the firm level. In particular, standardization strategy of SME (Small and Medium sized Enterprise)s is critical since they are experiencing liabilities of newness and smallness.

Building capabilities is one of essential equations in strategic management literature to achieve sustainable superior performance (Barney, 1991; Eisenhardt & Martin, 2000; Teece, 2007). Especially, the entrepreneur or SMEs need to have an innovative edge to compete against bigger incumbents (Rosenbusch, Brinckmann, & Bausch, 2011). The development firm's core innovation capabilities demands substantial resources (Van de Ven, 1986), and it clearly required the allocation of significant human and financial resources. However, unlike well-established incumbents, smaller resource-scarce firms struggle with the best resource allocation strategy for developing their core capabilities because the resources required by innovation capabilities (both standardization and R&D capabilities) can overstrain their possibilities (Acs & Audretsch, 1988; Nooteboom, 1994; Vossen, 1998). For SMEs facing liabilities of newness and smallness (Blind & Mangelsdorf, 2013), building capabilities is particularly important to survive in the belonging industry. When SMEs are in high-technology industries, allocating resources on building technological capabilities is essential. For this, the choices that SMEs can take are either go for the dominant design (standardization) or go for the R&D.

The goal of this paper is to investigate the impacts of the choice of SMEs' resource allocation between standardization and R&D on their financial performance. Although firms need to acquire both standardization and R&D capabilities simultaneously, SMEs generally suffer from relatively scarce resources. Hence, SMEs should decide the capability they are more focused on and locate themselves on the line of the two ends. In this research, we are seeking empirical findings of the best resource allocation strategy for SMEs, especially we take a deeper look when SMEs make more intensive investment in standardization and how this strategic decision influences firm's performance.

Our research model was tested using data from the Korea Standard Survey 2013, including 821 Korean small and medium sized firms in the information and technology, and electricity and electronics industries. The result shows that relative standardization

intensity has a U shaped impact on firm performance In sum, SMEs' strategic choice of resource allocation on either standardization or R&D positively influences firm's financial performance.

While prior research has not empirically investigated the impact of standardization on firm's performance, this study provides empirical evidence regarding the standardization-performance relationship at the firm level. Our research specifically focuses on SMEs and it uncovers the best strategic options for smaller resource-scarce firms. In the previous literature, the dominant view of standardization was a part of R&D process. This point of view fundamentally assumes that companies have sufficient resources to deal with both of activities. However, we address standardization as a strategic choice perspective in the specific context of resource-scarce SME organizations.

In this paper, we define the term standardization as activities of pursuing industry standards and of utilizing the industry standards for generating follow-up products. Large firms usually focus more on generating industry leading products, *de facto* standards, while small firms utilize the industry standards to manufacture products to fill recognized market niches. Our intention of using the term standardization in this paper is to utilize defined industry standards for generating follow-up products because our main target is SMEs.

II. Theoretical background

Innovation and standardization have been intertwined to explain various theoretical topics on innovation, even though scholars explicitly discuss these two factors. At the industry level, Anderson and Tushman (1990) introduce a cyclical model of technological change. They categorize two eras based on the emergence of a dominant design. Before the dominant design, an industry introduces diverse product introduction under high market uncertainties, called "the era of ferment". They introduce "the era of incremental changes" after the dominant design. The industry starts to produce products with minor changes to meet diverse customer demands. Utterback and Suarez (1993) define a dominant design as "a specific path, along an industry's design hierarchy, which

establishes dominance among competing design paths". Since firms are introducing various products with slight changes of the dominant design, it can be considered as one of examples of *de facto* standards.

Other theoretical papers also include standardization as an important component to explain the patterns of innovation (Utterback and Abernathy, 1975; Abernathy and Utterback, 1978). The basic understanding of the role of standardization is to increase the efficiencies in both product and process innovation. For the product innovation, standardization can reduce manufacturing costs to modularize common components. The economies of scope and scale can be achieved through standardization. For the process innovation, standardization is also necessary to share a certain manufacturing process with other products. When industry evolves over time, firms' strategic orientation is towards more standardization to achieve efficiencies compared to innovation.

Besides the industry level, standardization has been also used to explain a firm's motivation of product line extension lead to better financial performance at the firm level. For example, firms have incentives to increase their product lines for the potential benefits by having higher sales volumes with lower manufacturing costs (Bayus & Putsis Jr, 1999; Gimeno & Woo, 1999; Kekre & Srinivasan, 1990; Lancaster, 1990; Panzar & Willig, 1981). Product standardization is a key to achieve these advantages. If firms cannot reach the optimal level of standardization, they are suffering from inefficiencies (Giachetti & Dagnino, 2013).

Firms' focus on standardization usually works best when they can expand their knowledge within the industry boundary. As the concept of "creative destruction" by Schumpeter (1942) illustrates, an industry evolves over time, and new industry introduced by the new technological discontinuity can reshape the existing industry. Thus, attention on innovation is also necessary not to become obsolete in the industry.

In high velocity environment, it is difficult to have competitive advantage (Wiggins and Ruefli, 2002). Building capabilities for achieving competitive advantages is essential for firms to survive longer. Due to the liabilities of newness and smallness, SMEs need to strategically decide how they can build their capabilities. Investing R&D and standardization are the alternatives given to SMEs. Nevertheless, extant literature has not paid much attention on this question up to now.

In this paper, we propose two conflicting arguments regarding the relationship between standardization intensity and sales performance. First is a positive and linear relationship. As many current literature have concluded, firms can enjoy the results of allocating their resources into standardization. By interacting existing players in the market or by understanding technologies available in the market, firms are able to reduce market and product uncertainties which ultimately affect firm performance. However the marginal return of investing standardization will be decreasing and it may has some negative effects (Lages, Abrantes, & Lages, 2008). It brings our second argument that there is a curvilinear relationship between them. We elaborate our arguments one by one in next section.

III. Hypothesis development

As technologies advance, standards are required to ensure performance, conformity, and safety of new products and processes (Utterback, 1996). They provide high legal security in new fields of technology and reducing risks of liability, creating larger-scale markets and building confidence among consumers (European Commission, 2011). The benefits to use standards derive from positive network effects and economies of scale by ensuring product compatibility and interoperability, which in turn increase productivity of the workforce (Saltzman, Chatterjee, & Raman, 2008). Standards are specifications that determine the compatibility of different products (Stango, 2004), thus standardization can overcome many disadvantages related to a too wide variety of products. To avoid high switching costs as different technological systems may appear in the market after a while; the consumers are most likely to purchase a particular good, depending on the number of other consumers who purchase compatible goods (Ohashi, 2003). On the provider side, this positive consumption effect, called a network effect, increases economies of scale, and hence lower the price of products associated to the standard (Bekkers, Verspagen, & Smits, 2002). In their fight for competitive advantage, firms pick strategic options that enable them to save costs and effort to maximize their profit.

Even though, investment in R&D is crucial in the high-technology sectors such as IT,

and electronics industries with short product life cycle, SMEs typically considerable resource constraints, absence of economics of scale and scope, weaker absorptive capacity which are unfavorable characteristics for SMEs to go for R&D as their core competency. The lack of tangible and intangible resources of SMEs impairs investment in R&D (Blind & Mangelsdorf, 2013). Additionally, R&D investment implies increased uncertainty and risks (Eisenhardt & Martin, 2000; Oehmen, Olechowski, Robert Kenley, & Ben-Daya, 2014). While large firms have the resource slack to overcome failure, for SMEs the failure of a new project or product can endanger the existence of the organizations (Nohria & Gulati, 1996). Furthermore, big organizations are more likely to have experience with R&D project and developing new product (Danneels, 2002; Galunic & Rodan, 1998; Majchrzak, Cooper, & Neece, 2004). Since R&D investment involves high failure rates (Berggren & Nacher, 2001; Crawford, 1979) and temporary unprofitability (Block & MacMillan, 1993), smaller especially new firms with lack of R&D experience are often not capable of dealing with the risk embedded in R&D process (Rosenbusch et al., 2011).

Therefore, SMEs use alternative strategies to penetrate a market by adopting dominant design with less product and market uncertainties. In these lights, standardization is an attractive choice to SMEs. These arguments lead to the following hypothesis:

H1: Firm's standardization intensity has positive impact on its performance.

Although prior research generally indicates the overall beneficial effect of standardization, some scholars have also suggested other considerations that a standardization strategy can come with disadvantages (Lages, Abrantes, & Lages, 2008). Standards are the outcome of a consensus process of all interested parties (Sherif, 2006) and often prohibit alternative innovative solutions. Thus standards consequently can create lock-ins in existing technologies (Blind, 2009), and this lock-in effects decreases firm's competitive capability when a new generation of systems create a new market. From the industry structure points of view, a new generation of standards is defined at the interval of several years, it will create a new market, thus giving an opportunity for new players to enter the market and become major players in the new systems. If the incumbent players stick to existing dominant design and pour their all efforts into developing standardization capability, they face the challenge of being locked into the legacy systems they have

invested in (Kano, 2000). Consequently, despite its demonstrated benefits, standardization may not always improve performance (Anderson & Tushman, 1990).

One of distinctive characteristics of SMEs is liabilities of newness and smallness (Blind & Mangelsdorf, 2013). Compared to large companies which can invest both on R&D and on standardization, SMEs have relatively small resources to invest these two strategies. SME's motives of investing R&D is to pursue their own strategy. Since SMEs are nimbler than other lager competitors, they can move faster and, hence introduce new products, services, processes, or business models that attractive niches. This uniqueness is an opportunity for SMEs to stand out from competition (Porter, 1980) and can profit from high brand loyalty and customer valuing (Lieberman & Montgomery, 1988). Compared to large firms, serving attractive niches is particularly advantageous for SMEs due to their limited size and greater nimbleness. All of these benefits help SMEs to successfully compete with well-established incumbents that can utilize a much larger resource base. By offering highly tailored to niches and unique products, small firms can avoid price competition (Porter, 1980; Rosenbusch et al., 2011). With respect to invest standardization, however, SMEs have huge incentives of focusing standardization. Unlike the case of large companies, SMEs'entry into market after the *de facto* standard is by utilizing or enhancing existing standards.

From different benefits of standardization and R&D, the balance between standardization and R&D is critical for a firm's survival. However, SMEs are suffering from the lack of financial resources to invest in both strategies. Thus, SMEs may expect higher financial returns when firms are allocating their resources either in R&D or in standardization. Therefore we hypothesize:

H2: Firm's standardization intensity and its performance have a U-shaped relationship.

IV. Method

1. Sample

The data is from the Korea Standard Survey 2013, including 1,000 Korean small and

medium sized firms in the information and technology, and electricity and electronics industries. The Korea Standard Survey was conducted by Korean Standards Association to understand standard activities of Korean firms. The survey used a mixed method with face-to-face, telephone, email, and fax interviews to increase the response rate. The samples of these industries have been widely adopted in the prior literature, because standards are essential to increase compatibility among products (Bekkers et al., 2002; Ohashi, 2003; Yoo et al., 2005). The samples were selected by the stratified sampling with the power allocation method. Due to missing observations, our final sample consists of 821 firms. Among 821 firms, 48.5%(395) firms are from electricity and electronics industry, and 51.5% (419) firms are from information and communication technology industry. Firms from information and communication technology industry show 48% R&D intensity and 2.4% standardization intensity, while firms in electricity and electronics industry have 46% R&D intensity and 1.4% standardization intensity. Across the sample, the average annual sales of the firm are around 25 million U.S. dollars. The average expenditure of standardization of the target firm is approximately $7260 and their average investment in R&D is around 0.82 million U.S. dollars. In terms of sample characteristics, the average age of each company is 14.6 years and the average number of employees is 70.16.

Korean firms have become leading multinational organizations in many R&D-intensive industries, including the semiconductor, electronics, display, and automobile industries, and these firms are frequently used in studies on firm innovation because of their rapid transition from imitators to innovators (Kim, Kim, & Lee, 2008). Hence, the Korean economy provides a good research setting for understanding the impact of firms' strategies on R&D and standardization.

2. Variables

Dependent variable. We use a natural logarithm of sales to measure firm performance (Barling & Beattie, 2008).

Independent variables. We use the relative investment of R&D and standardization investments. It is measured as standardization investment divided by the sum of R&D

and standardization investments. The larger value of the relative standardization means that firms invest more on standardization compared to R&D investments.

Control variables. We also include several control variables. Firm age was measured as a natural logarithm of years since established (Kim et al., 2008). Firm size was measured as a natural logarithm of nu8mber of employees (Ettlie, Bridges, & O'Keefe, 1984; Kollmer & Dowling, 2004). We control dummies for firms listed in either the Korea Composite Stock Price Index (KOSPI) or Korean Securities Dealers Automated Quotations (KOSDAQ) markets. Also industry dummies are also included.

V. Results

1. Hypothesis testing

〈Table 1〉 shows means, standard deviations, and the correlations between all variables. All correlations except between firm sales and firm size, and relative standardization and its square term show low and medium correlations. Hence multicollinearity was not a problem in our dataset. We also examine the variance inflation factors (VIFs) to test potential multicollinearity. The VIF scores of all model show less than 10, which is a cut-off point of determining the issue. Hence our models are less likely to have multicollinearity.

〈Table 1〉 Descriptive statistics and correlations

Variable	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)
(1) Log (Sales)	8.92	1.43						
(2) Relative standard. intensity	0.04	0.08	-0.116					
(3) Relative standard. intensity^2	0.01	0.03	-0.070	0.929				
(4) Log (firm age)	2.50	0.64	0.280	-0.012	-0.003			
(5) Log (firm size)	3.64	0.97	0.835	-0.136	-0.100	0.245		
(6) Dummy for KOSPI	0.02	0.13	0.315	-0.026	-0.025	0.208	0.326	
(7) Dummy for KOSDAQ	0.05	0.22	0.387	-0.044	-0.018	0.140	0.399	-0.032

Note.
N = 821.

〈Table 2〉 contains the results of OLS regressions on firm performance. Model 1 only includes control variables. Model 2 adds the relative standardization intensity, and Model 3 includes the squared term of the relative standardization intensity to test a curvilinear relationship between relative standardization intensity over R&D intensity.

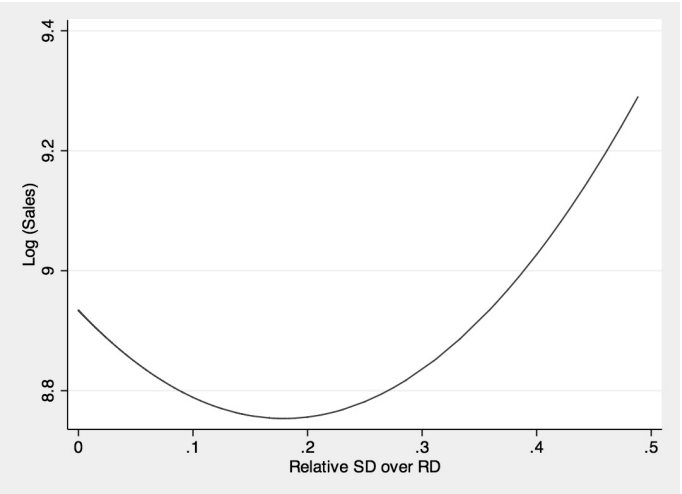
In Model 2, we hypothesize a positive and linear relationship between relative standardization intensity and financial performance. The coefficient of relative standardization intensity is negative but insignificant (β = -0.161, not significant).

The result does not support Hypothesis 1. Although we posit that there could exist a curvilinear relationship between relative standardization intensity and financial return, the result in Model 3 shows a negative and significant coefficient for the non-squared term (β = -2.011, p 〈 0.05), and also a positive and significant coefficient for the squared term (β = 5.610, p 〈 0.05). This means that our result supports the curvilinear (U shaped) relationship between relative standardization intensity and financial performance.

〈Table 2〉 Results of OLS regressions

	Model 1	Model 2	Model 3
Relative standardization intensity		-0.161	-2.011*
		(0.294)	(0.918)
Relative standardization intensity^2			5.610*
			(2.365)
Intercept	4.011***	4.028***	4.071***
	(0.352)	(0.354)	(0.353)
Log (firm age)	0.132**	0.132**	0.131**
	(0.047)	(0.047)	(0.047)
Log (firm size)	1.134***	1.132***	1.128***
	(0.035)	(0.036)	(0.036)
Dummy for KOSPI	0.491**	0.494**	0.508**
	(0.179)	(0.178)	(0.174)
Dummy for KOSDAQ	0.473***	0.474***	0.464***
	(0.139)	(0.139)	(0.140)
Adj. R-sq	0.703	0.702	0.704
F	334.9***	288.9***	256.9***

Note.
N = 821, Robust standard errors in parentheses (^{+}p 〈 0.10, $^{*}p$ 〈 0.05, $^{**}p$ 〈 0.01, $^{***}p$ 〈 0.001).



〈Figure 1〉 Graph of the curvilinear relationship

VI. Discussion and conclusion

Going for the industry standards or going for the R&D is an important question for SMEs to allocate their resources depending on strategic orientation. Rooted in the extant theory, we hypothesize two alternative hypotheses between relative standardization intensity and financial performance: a positive linear and a U-shaped. The positive linear relationship comes from the potential benefits from less technological and market uncertainty. It works particularly for SMEs suffering from lack of resources. However, high standardization intensity can harm firm performance because of lack of competitive advantages compared to competitors.

Our findings on these two alternative hypotheses support that only the U shaped relationship exists in the case of Korean SMEs. The possible explanation of this finding is distinctive motivations depending on the types of firms. For large and incumbent firms, they have greater incentives of generating industry-leading products as well as maintaining their market position. For generating leading products, firms invest greater R&D, and they also invest standardization to maintain their market position. However, SMEs have less incentives of creating the industry-best product because of resource scarcity. Rather allocating greater resources on newly developed product, it will be

better to find out market niches by modifying the industry-leading products.

Hence, the positive linear relationship illustrates that SMEs with scarce resources can expect better performance when they focus on standardization. In other words, when the orientation of capability building is toward more certain (i.e., focusing on *de facto* standards in the industry), SMEs can obtain better financial performance.

Following up with our main finding, we test the question of which standards they should focus more to acquire better performance. Our results of ad-hoc analysis provide that domestic standards activities work better to enhance firm performance, while intentional standards activities do not. SMEs need to have appropriate absorptive capacity to understand the developed technologies. Higher absorptive capacity means that firms needs to invest more resources to increase such capability. Additionally, since technology advancement does not guarantee the success in the industry, understanding the target market is critical for firms to create competitive products. If they are targeting foreign markets, SMEs are more likely to suffer information asymmetry. To overcome this problem, they should invest more resources to reduce the entry barriers. However, it is difficult for SMEs to invest more resources under the liabilities of newness and smallness (Lu & Beamish, 2001). Hence, SMEs can expect better performance when their target market is domestic market by involving domestic standardization activities.

Although our results do not support the importance of R&D, we still believe that R&D should be along with standardization. As many scholars have discussed, standardization and innovation are highly influenced each other. Due to the heterogeneous immediate goals, small and large firms may have different incentives to set their strategic orientation. For SMEs, their immediate goal is to dive into adjacent markets where they have knowledge to modify or imitate the industry standards, while large firms have incentives of creating products as an industry standard for their monopolistic market position.

Additionally, we carried out further analyze whether our finding is consistent depending on firm and industry characteristics. Regardless of industry categorization, our finding is consistent. Also we subsampled high and low R&D intensity and standardization intensity which measured one standard deviation above and below the mean value. In case of low R&D intensity and high standardization intensity, we find that our finding

is consistent. It implies that a firm's sales performance has a curvlinear relationship with standardization intensity when it is highly depending upon standardization as a means of knowledge acquisition.

1. Conclusion

Standards are important to expand markets, to increase product compatibility for generating the network effect and to escalate the efficiencies of product and process innovation. Although prior studies have discussed deeply on the role of standardization in the industry and innovation theories, few studies have studied on the standardization and R&D as a strategic weapon. At the firm level, the optimal resource allocation strategy is required on the line of two extreme ends between standardization and R&D. Focusing on standardization implies that firms want to develop products following by the defined industry standards, which indicates less technology and market uncertainties, while R&D means that firms develop their own technological capabilities, while illustrates high technology and market uncertainties. Under the liabilities of newness and smallness of SMEs, the strategic resource allocation is critical to determine the fate of firms. However, this question still remains unanswered.

To test the research question, we used the sample of 821 Korean SMEs in the information and technology, and electricity and electronics industries. Our result showed that there is a positive and linear relationship between standardization and performance. Additionally, we also tested how domestic and international standardization activities influence financial performance. Our ad hoc analysis supported that SMEs generate better financial performance when they focus more on domestic standardization.

2. Theoretical and political implications

From a theoretical perspective this study advances prior research in two ways. First, we shed a light on the strategic view of standardization at the firm level. Although standardization has been paid much attention by scholars over the years, most of

existing literature has seen standardization as a part of the technological evolution in both product and process innovation perspectives (Utterback and Abernathy, 1975; Abernathy and Utterback, 1978). And also they have focused the relationship between standardization and innovation, such as standardization is considered as either inhibitor or catalyst of innovation. However, firms consider standardization and R&D as a strategic choice. For standardization, early entrants want their products to be selected as a dominant design in the market because it will bring the benefits, such as greater market shares and technological advances (Suarez & Utterback, 1995), while late entrants have a choice either developing a new dominant design (new standard in the industry) or following the industry standard. The large firms usually have more incentives to pursue the former one, whereas SMEs are struggling to answer for the latter situation because most SMEs are suffering from the liabilities of newness and smallness. Depending on the choice between they choose R&D for new standard in the industry and following the existing industry standard, their strategic orientation including resource allocation will be determined. While SMEs need to develop their core capabilities with best resource allocation strategy to compete against large incumbents, dominant view on standardization have not provided proper insight to SMEs. Yet, we address standardization as a strategic choice perspective especially in the specific context of smaller, resource-scarce organizations.

Second, our research provides unique empirical evidence regarding the impact of standardization-performance relationship at the firm level. In the previous literature, scholars mostly investigated specific cases of standard war or economic outcomes of standardization at the national or industrial level. However, little empirical research has directly addressed the relationship between standardization and performance at the firm level. In particular, there is no empirical support for the SMEs' standardization efforts up to now. Yet, we specifically focus on SMEs and empirically explore and show that how standardization activities influence firm's financial performance.

From a managerial standpoint, our results provide novel insights to SMEs manager. Although firms need to acquire both standardization and R&D capabilities in order to achieve sustainable superior performance, for SMEs facing liabilities of newness and smallness, standardization is an important resource allocation decision that of how they locate themselves on the line of the two ends and where they put more effort between

standardization and R&D with limited resources. Our empirical evidence provides the best resource allocation strategy for SMEs, particularly for the firms in the high-technology sectors with short product life cycle to survive in the belonging industry. Following our findings, we propose that managers for resource-scarce, smaller entities should invest more into standardization activities for better financial performance, especially for the short-term returns. More specifically, SMEs mangers are advised to focus on domestic standards to obtain better profit.

3. Limitations and suggestions for future research

Although this paper contributes to extant literature in several folds, there also are few limitations. First, since this analysis has tested using the sample of Korean SMEs in the information and technology, and electricity and electronics industries, our finding between standardization intensity and financial performance cannot be easily generalized to other firm sizes, countries and industries. Particularly, depending on the stage of industry development (i.e., whether an industry is just emerged in the market or is already saturated), the importance of standardization is changed. Hence, studies from diverse country and industry settings are essential to understand the details on standards. Alternatively, by collecting a company and country level data, further study discussing unique conditions compared to other countries is required to understand the details. Second, as we discussed in the prior section, there may exist different motivations between large and incumbent firms, and small and medium-sized firms. For large firms, they have incentives of having products leading to industry standards for their monopolistic power. Since the motivation requires substantial investments on R&D, the relative importance of standardization may decrease. On the other hand, SMEs continuously have incentives of greater utilization of standards under limited resources. Although we have empirically tested in the case of SMEs, further studies are required to investigate the large firms' motivations. Lastly, in terms of data, our data is cross-sectional. One of potential problems of using the cross-sectional data is that we cannot consider time gaps between standardization strategy and its performance. Hence, we want to pursue future research on the impacts of standardization using a panel data.

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강광욱

Rensselaer Polytechnic Institute에서 2013년에 경영학 박사학위를 취득하고, 현재 UNIST의 경영학부 조교수로 재직 중이다. 관심분야는 와해성 혁신, 기술혁신이론, 기업의 지배구조 등이다.